

A silhouette of an F/A-18 Hornet fighter jet in flight against a sunset sky. The jet is carrying several missiles on its wings and tail. The background shows a dark, hilly landscape under a cloudy sky with a bright sun setting on the horizon.

F/A-18

- **FCC V10.7 Software Upgrade**
- **Fleet Departure Training Program**



FCC Upgrade Program Drivers

16 Hornets lost due to OOCF

- 7 aircraft lost in last few years resulting in one lost aircrew/>\$225M in hardware

Estimate Navy/USMC will lose 10 additional H the life of the aircraft

**Improve the flying qualities
&**

departure resistance of A-D Hornets





Program Goals

Improve Flying Qualities & Redundancy Management



The basic process:

- Implement E/F High AOA Architecture
- Make Adaptations for A-D Architecture Where Required
- Tailor Gains to F/A-18A-D Aerodynamics
- Stay Away from Single-Axis Operational Envelope Changes



Improved Flying Qualities

- **Improved Falling Leaf suppression**
 - No sustained motion in F/A-18E/F with similar FCC a
- **Improved departure *resistance***
 - Two-place + centerline tank near 35° AOA
 - Two-place high subsonic, high AOA (NATOPS placard)
 - Rudder inputs near zero AOA
 - Other aggravated inputs (lat + aft)
- **Improved roll performance 30-50° AOA**
 - Implement E/F-like “pirouette” control law feature
 - Use of opposite differential stabilator to improve yaw



Impact to Flight Envelope

- Beta/Betadot Crossfeed Departure Resistance Enhancement:
 - $AOA > 16$
 - Subsonic Only; Required at High Subsonic for 2P Issue
- Enhanced Maneuvering:
 - $AOA > 20$ Only
 - Full Implementation for $Mach \leq 0.45$; Out for $Mach \geq 0.55$
- Pitch/Roll Inertial Coupling Limiter Features
 - Similar to E/F
 - Invoked for Multi-Axis Inputs
 - Should be Invisible for Single-Axis Maneuvering



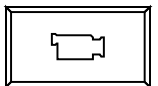
Redundancy Management Upgrades

- FCC logic change to limit A/P stab authority while ACLS engaged
- AOA selection logic
- 16 additional controllability/BIT improvements
 - * HDU impact



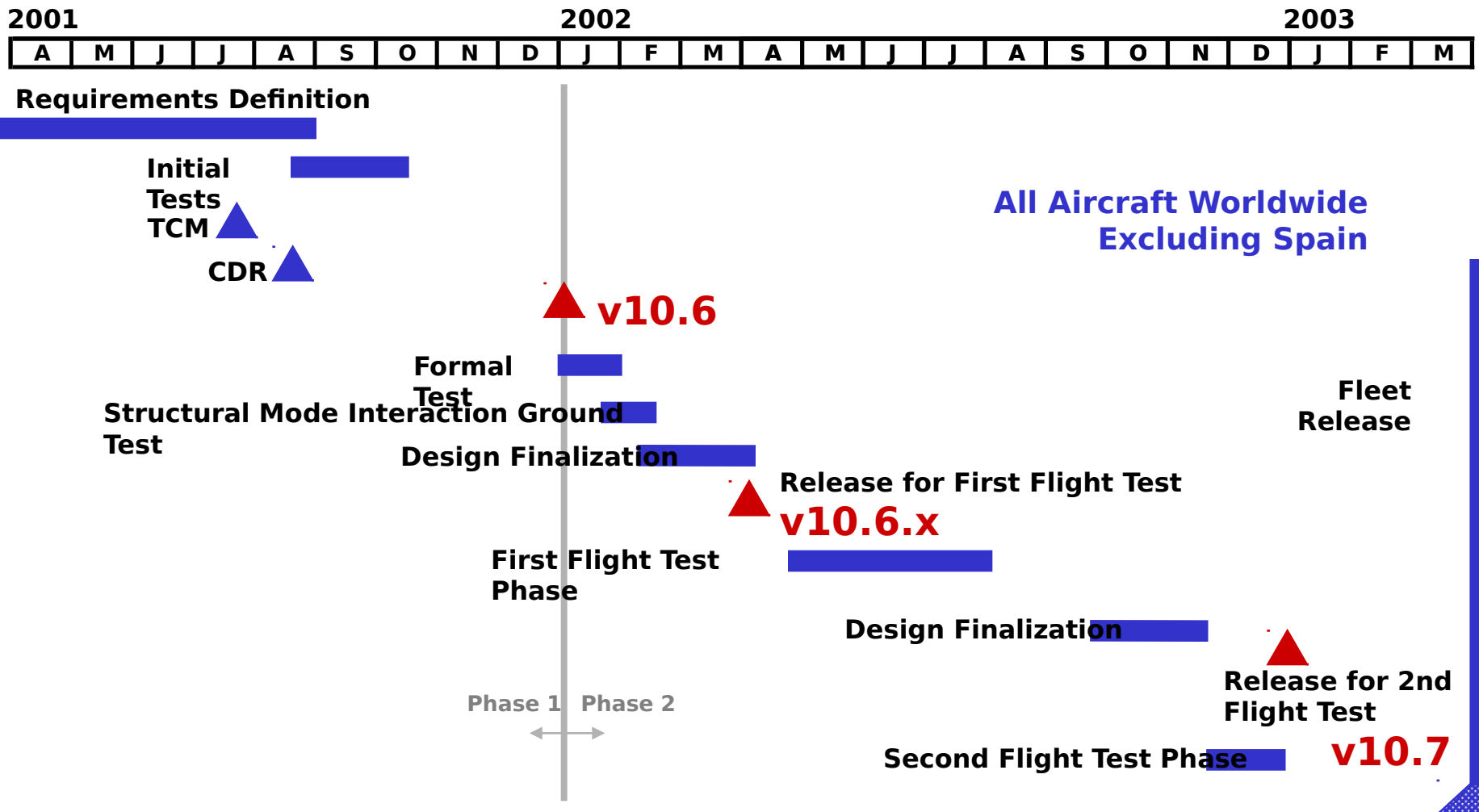
Program Status

- **Program is funded and on track**
- **First flight May 02**
- **Fleet release early CY03**





FCC Upgrade Schedule





Departure Training Program

Hornet Executive Steering Committee - May 2000

“NAVAIR develop a FRS Departure Training Program”

- Minimal OOCF in-flight training for Student Naval Aviators
- End of T-2 Spin Training Program
- Increasing number of fleet OOCF mishaps

Maneuvers developed and tested from 1992-1994

Strike Aircraft Test Squadron built experience from 1994-2001

Over 2000 intentional departures



Program Objective's

Expose pilots to the advanced handling characteristics of the F/A-18 through flight demo of:

- *Impending departure cues*
 - *Aircraft departure characteristics*
 - *Recovery procedures*

***Focus on departure avoidance
and
departure recovery***



Program Design

FRS Departure Training Program began in March 2001

Learning objectives accomplished in three phases:

- Technical briefings
- Simulation
- Controlled exposure to high AOA and departed flight conditions



Departure Program Syllabus

Academic Syllabus

- **Video**

The Edge of the Envelope: Understanding the F/A-18 Out of Control

- **Briefings**

High AOA Flying Qualities and Departure Characteristics Briefing

Flight Control Surface Rigging and Radome Briefing

Simulator Training

- Maneuvers and cockpit procedures
- Review departure recognition cues, recovery procedures, and lessons learned



Departure Program Syllabus

Flight Training

(1 flight for student pilots, 3 for IUT)

- Pre-flight Spin Recovery Mode Check
- Airborne Rig Check (as required)
- High AOA Static Stability Demo and Radome Check
- Accelerated Flight Radome Check
- Automatic Spin Recovery Mode Demonstration
- Low AOA / Rudder Departure Demonstration (*deleted with 10.7*)
- Vertical Departures
 - Tail Slide
 - 100 Kt Vertical Recoveries



Program Status

- **Model Manager...Naval Test Pilot School**
- **VFA-106 (NAS Oceana)**
 - Initiated training in March 01
 - 92 RPs and 8 instructors trained
- **VFA-125 (NAS Lemoore)**
 - Initiated training in January 02
 - 63 RP's and 6 instructors trained
- **VMFAT-101 (MCAS Miramar)**
 - *Status TBD*



Fleet Concerns

(NAVAIR assessment of A/C Impacts)

- **Fatigue Life Expectance (FLE) imp**
- **Impact to engine**

significant increase in measurable FLE rates on aircraft in departure training program



Fleet Concerns

FLE Data from VFA-106 F/A-18B/D Aircraft

Pre-Departure Training

(Sep 2000-Apr 2001)

	DH	WR	WF	LH	RH	FF	Z3
Maximum	2.354	0.228	0.131	0.049	0.051	0.001	0.327
Median	1.284	0.081	0.042	0.010	0.009	0.000	0.111
Minimum	0.102	0.002	0.001	0.000	0.000	0.000	0.000

Post Departure Training

(May 2001-Jul 2002)

	DH	WR	WF	LH	RH	FF	Z3
Maximum	1.894	0.222	0.139	0.058	0.059	0.001	0.313
Median	1.284	0.081	0.042	0.010	0.009	0.000	0.109
Minimum	0.102	0.002	0.001	0.000	0.000	0.000	0.000



Summary

- Program established and making an impact (HAZREP)
- Highly recommended by VFA-106/125
- No primary FLE impacts/engine impacts

**10.7 increases departure *resistance*,
~~improves recovery~~**

**OOCF syllabus teaches impending departure
recognition,**

Reinforces *recovery techniques*



Back Ups



Informal feedback/VFA-125 Critiques

- Like three-phased training (classroom, simulator, flight)
- Training materials organized and effective(video, briefings, flight cards)
- Participants report increased confidence in personal ability to handle OOCF situations and in aircraft ability to recover from OOCF
- In-flight experience with spin recovery mode and cockpit cues invaluable



Foreign Military Sales Customers

– **Finnish Air Force**

- Program implemented in 1997
- Ground training materials updated January 2002

– **Swiss Air Force**

- Program implemented in 1998
- Ground training materials updated February 2002

– **Spanish Air Force**

- Implementing the program in March 2002



Redundancy Management Upgrades

- PBIT GO overriding IBIT degrade
- Leading Edge Flap (LEF) inboard command versus position and FLAP SCHED caution
- Misleading MSP codes set during engine shutdown
- AOA monitor tolerance in PA
- FCS caution with MC1 off
- Loss of hydraulic pressure for rudder actuator
- Intermittent function 66 engagements with single AOA probe failure
- ACLS pitch-trim limiter authority
- Impact pressure calculated AOA in UA configuration
- Leading edge flap asymmetry with flaps down
- Leading edge flap stall monitor
- Aileron/rudder ASM update
- Mechanical reversion PBIT code



Redundancy Management Upgrades

- PA pitch trim integrator initialization to 8.1 degrees after Autopilot (AP) disengagement
- Reduced departure susceptibility with an AOA probe jammed close to zero degrees
- Throttle back drives monitor correction to eliminate nuisance failures for fast reengagement of ATC
- Eliminate nuisance IBIT failures when atmospheric pressure is too high
- LEF ASM Departure Warning Path FLAP SCHED Caution Not Asserted Long Enough
- Zero AOA Diff w/ SPINF, G'Oride & SPIN PA_AOA_Fail Clear.
- Eliminate AOA local freeze when large split present
- Modify flight phase logic versus a few yaw axis gains while PA_AOA_FAIL
- Several other AOA selection logic changes